Thermodynamics of $N_2(l) \rightarrow N_2(g)$

Recommended for Chapter(s): 9

Demo #030

Materials NOT in box

1. Safety goggles.
2. Liquid nitrogen (get liquid nitrogen from the cage near shipping a receiving).
3. Cryo gloves (general cabinet).

Procedure

1. (Prep) Take the liquid nitrogen dewar (and the cryo gloves) from the general cabinet and get liquid nitrogen. The $N_2(l)$ is located outside chemistry shipping and receiving. E-mail Darby for the project code (feldwinn@chem.ucsb.edu).
2. Pour liquid nitrogen into the 500 mL Erlenmeyer flask until the flask has approximately ¼ inch of liquid nitrogen in it.
3. Place a balloon on top of the flask.
4. The balloon will expand as the nitrogen heats up and changes from a liquid into a gas. This will happen very fast. There is a pin in the box to pop the balloon once it blows up. Be careful if you try to remove the balloon because the air that escapes is very cold and can burn you if you are not wearing the cryo gloves. If you let it go until it pops it is very loud.

Safety

1. Wear safety goggles.

Clean Up

1. Return the materials to the cart in the demonstration library room.

Stockroom Notes

1. Put clean glassware in the demonstration tub.
2. Return items to demonstration tub.
3. Return tub to the demonstration library.
    a. Return the dewar and the cryo gloves go in the general cabinet.
    b. Return goggles to goggle box.

Discussion

This demonstration can be used to reinforce what the signs of ΔE, q, and w are. After performing the demonstration, ask students for the sign of q for the reaction $N_2(l) \rightarrow N_2(g)$. Heat is positive when heat leaves the system and negative when heat enters the system. Since the system is warmer after the $N_2(l)$ has changed to $N_2(g)$, heat entered the system and q is positive.

Ask students what the sign of w is. Work is negative when the system does work on the surroundings (system expands) and is positive when work is done on the system (system contracts). Since the balloon expanded the system did work on the surroundings and w is negative.

Ask students if they can predict the sign of ΔE. Heat, q, is positive and work, w, is negative, therefore, since $\Delta E = q + w$ there is not enough information to predict the sign of ΔE.

Materials for demo 030

1. 500 mL Erlenmeyer flask
2. Balloons
3. Pin